04 Extension Note

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Interim Validation of the Western Hemlock Growth Intercept Model

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Introduction

Growth intercept models estimate site index (a measure of site productivity) from average tree height growth measured immediately above breast height. These models have been developed for four species: coastal western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) (Nigh 1996a) and Sitka spruce (*Picea sitchensis* (Bong.) Carr.) (Nigh 1996b); interior lodgepole pine (*Pinus contorta* Dougl.) (Nigh 1995a) and spruce (*P. glauca* (Moench) Voss, *P. engelmannii* Parry, and *P. glauca* x *engelmannii*) (Nigh 1995b). Growth intercept models are expected to be developed for all commercial species in British Columbia.

It is important that these models be validated (tested). Growth intercept models are empirical; hence they strongly reflect the behaviour of the model development data. Therefore, testing them with independent data (that is, data that were not used to develop the model) is important because the model development data may be atypical (Picard and Cook 1984). If a model validates well against an independent data set, it does not mean that it is correct; it simply provides more evidence that the model is adequate (Oreskes et al. 1994).

This Extension Note describes the interim validation of the coastal western hemlock growth intercept model.

Data, Methods, and Results

The validation data set consists of six hemlock stem analysis plots. Three trees that expressed the potential productivity of the site were selected as sample trees. The sample trees were felled and sectioned, and their height growth was recreated. The growth intercept for breast height ages 1, 2, ..., 30 and the site index were calculated (equations [1] and [2], respectively) from the height-age data. More information about the data and how it was manipulated can be found by consulting the publication describing the model development (Nigh 1996a).

$$[1] \quad GI = \frac{H_A - 1.3}{A - 0.5} \times 100$$

$$[2] \quad SI = \frac{1}{3} \times \sum_{i=1}^{3} H_{50,i} \ ,$$

where: GI = growth intercept (cm/yr),
H_A = average height (m) at breast height age A,
A = breast height age (yrs),
SI = site index (m @ breast height age 50), and
i = indexing variable.

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Site index was estimated from the growth intercept and the appropriate growth intercept function for coastal western hemlock (Nigh 1996a). The errors in the estimates (actual site index–estimated site index) were calculated and averaged for each age from one to 30. Errors that are less than zero indicate that the model is overestimating site index. Figure 1 shows the errors in estimated site index, the mean error, and a 95% confidence interval for the mean. The error was not significantly different from zero at any age. Therefore, the results did not show any evidence of bias in the model.

Discussion and Conclusion

There are many ways of validating a model, each with its own advantages and disadvantages. Validation may consist of corroborating the model, that is, utilizing "the structure and properties of a model to determine model adequacy" (Oderwald and Hans 1993), or it may involve evaluating the performance of the model (comparing predictions to actual data) (Buchman and Shifley 1983; Goulding 1979). Model performance (or predictive ability) is my main concern when validating a growth intercept model. Therefore, I was

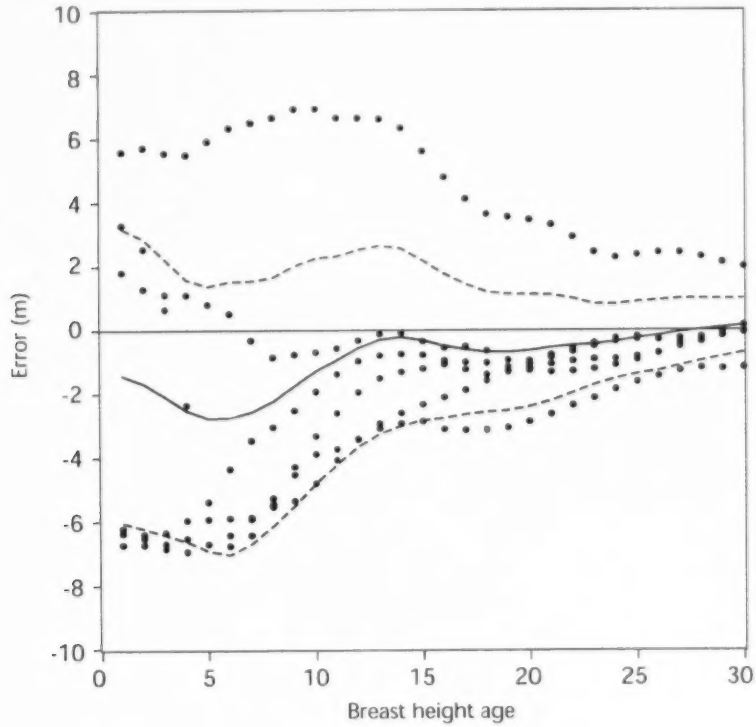

FIGURE 1 *Plot of individual errors in estimated site index (•), mean error (———), and a 95% confidence interval for the mean error (- - - -) against breast height age.*

primarily interested in detecting evidence of bias. Precision is also important, but the data set was too small to provide much information about precision.

This analysis did not reveal any evidence of bias in the coastal western hemlock growth intercept model. However, the sample size was extremely small and hence this validation should be considered interim. The model requires further validation with a larger independent data set.

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